Cluster Aspects of ^{252}Cf Spontaneous Fission

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Based on gamma coincidence data obtained with Gammasphere yields of specific two-fragment combinations can be directly determined in a two- dimensional yield matrix. The largest matrix of ^{252}Cf spontaneous fission product yield data comes from the Mo-Ba split. These yields, which are shown in Ref. [1], show that this split is unique in that it has an unusual component of 8-10 neutron-emission at a level of about 7% of the total integrated yields of Mo-Ba.

The idea of two co-existing fission modes is not new. Hulet*et al* [2] suggested the occurrence of two different fission processes leading to two modes of fission. What is new in the spontaneous fission of ^{252}Cf is that the low $\langle TKE \rangle$ mode manifests itself through the same primary mass split ^{106}Mo–^{146}Ba, which is one of the most abundant primary pairs emerging in the "normal" mode.

In order to extract the essential physical ingredients characterizing the data we performed a study which considered a minimum number of adjustable parameters and made use of whatever constraints on parameters available from other fission data. The details of this study are given in Ref. [3], and its main result is that it associates the low $\langle TKE \rangle$ (i.e. highly excited fragments) mode to a cluster structure of the Ba fragment at scission, in which a ^{14}C forms a neck between the Mo fragment and a ^{132}Sn cluster. After scission, the C and Sn clusters recoalesce, forming a highly excited Ba fragment. This process accounts for the apparent unequal partition of excitation energy between the Ba and the Mo fragments, and furthermore appears to be in agreement with the recent work of Pyatkov *et al.*.[4], which show more than one valley as scission is approached, some of which leading to shapes of the fissioning system close to what we would expect of a quasi-ternary mode as the one described above.

References

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